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REBROADCAST #341: Fume with a view: Consumer products and your indoor air quality

VOICEOVER

This is Up Close, the research talk show from the University of Melbourne, Australia.

ANDI HORVATH

I'm Dr Andi Horvath. Thanks for joining us. Today we bring you up close to investigations about our indoor air quality. Living in urban environments we're often very conscious of pollutants outdoors, yet the indoor air environment can be a greater hazard to human health. Listeners may be familiar with the term "sick building syndrome". It was coined a few decades ago. It's often used to describe unhealthy office workspaces. The combination of air conditioning ventilation systems, moulds, gases from chemicals used in building materials, office machinery and fabrics are increasingly under scrutiny. Meanwhile in the home, consumer products like air fresheners as well as cleaning, laundry and personal care products all emit a range of what are known as volatile organic compounds, or VOCs. Some of these can cause harm to human health and indoor air quality yet the ingredients are not often disclosed to the public. This is something civil and environmental engineer Anne Steinemann, our guest today on Up Close, would like to see change.

Anne is an internationally recognised expert on environmental pollutants, who's also found that current consumer products marketed as green, all natural, non-toxic or organic were not significantly different from conventional products when it comes to hazardous VOCs. Anne is now Professor of Civil Engineering and the Chair of Sustainable Cities in the Department of Infrastructure and Engineering, University of Melbourne. Welcome to Up Close, Anne.

ANNE STEINEMANN:

Thank you so much, Andi.

ANDI HORVATH:

Now Anne, what does indoor air quality actually refer to and why should we be concerned about it?

ANNE STEINEMANN:

Indoor air quality refers to the health of our indoor air environment. It's very interesting because we tend to think that most of our exposure to pollutants occurs outdoors but in fact more than 90 per cent of our exposure to pollutants that affect our health and productivity and wellbeing occur in our indoor environments, which can include our homes, schools, offices as well as transportation.

ANDI HORVATH:

What makes this so-called sick building sick?

ANNE STEINEMANN:

Well a sick building means that the indoor air quality is causing adverse health effects in its occupants and buildings can be sick for any number of reasons and types of pollutants. Some of the most common sources are the building materials and furnishings and consumer products used indoors.

ANDI HORVATH:

Can you describe for us some of the poor air quality and its effect on human health? I know quite a few people email you. What sort of medical issues are they coming up with?

ANNE STEINEMANN:

Well I've received more than 3000 emails from people around the world telling me that they became sick from their indoor air environments and the types of health effects are diverse from headaches, dizziness, breathing difficulties, asthma attacks, seizures, nausea, flu-like fever symptoms, cold-like symptoms, gastrointestinal problems - so a range of adverse health effects due to exposure to indoor air pollutants.

ANDI HORVATH:

How pervasive is poor indoor air quality and how does it differ to say the home environment or the office environment, school, shopping centre or even public buildings?

ANNE STEINEMANN:

Well let me just say that indoor air quality problems are pervasive. They're ubiquitous. They're around the world. They are common to virtually all indoor air environments whether it's a home, school, office, a car, a train. The types of pollutants may be different but the underlying theme is the same, is that people are becoming sick from exposure to pollutants that are common indoors. And the irony is that most of our exposure to hazardous pollutants occurs precisely in those environments that we consider safe, our homes, in our offices, our indoor air environments. That's what my research is investigating, is what are the sources of these pollutants and what can we do about it?

ANDI HORVATH:

Anne, take us into an office and portray the chemical environment. Where are the

chemicals emanating from?

ANNE STEINEMANN:

The chemicals can be coming from any number of places but the primary sources are building materials and consumer products such as cleaning products, air fresheners, and personal care products used by people indoors. It can be from the building materials like the paints and the carpets and the furnishings, manufactured wood products, varnishes. The types of pollutants that we find indoors that are causing health problems are actually quite different than they were 50 years ago because we have a lot more volatile organic compounds, semivolatile organic compounds and new types of materials that didn't exist 50 years ago.

ANDI HORVATH:

This is quite separate to microbial infestations, fungal infestations and ventilation problems as well as carbon dioxide?

ANNE STEINEMANN:

Right so I have focused on the chemical pollutants but things such as mould can also cause problems with indoor air quality.

ANDI HORVATH:

People have different levels of sensitivity to these chemicals but nevertheless when you see patterns of people getting sick in these environments it normally indicates there's something there.

ANNE STEINEMANN:

Exactly. Everyone is chemically sensitive to some extent. Some people have very severe acute reactions such as seizures or asthma attacks or headaches where other people may be affected by they don't realise they're being harmed by the chemicals. This is why I call this problem the 'hidden hazards' because the hazards are hidden in three main ways. First is the chemicals. We don't necessarily see the potentially hazardous chemicals in our indoor air environment. Another reason that they're hidden is that the effects are often very subtle and cumulative and subclinical. They don't manifest in a dramatic disease the minute you're exposed because we're exposed to these chemicals chronically from many different sources throughout our daily life. Another reason that they're hidden hazards is that these potentially hazardous chemicals are not generally disclosed on product labels or material safety data sheets. Again it's this paradox. It's where most of our exposure to hazardous pollutants that affect our health occurs indoors but these indoor environments are not regulated and the primary sources of pollutants are not required to disclose all of their ingredients.

ANDI HORVATH:

During this interview, Anne, you've used to the term potentially hazardous. Are things hazardous or are they potentially hazardous? Can you just clarify that term for us?

ANNE STEINEMANN:

Thank you so much for asking that question, for the opportunity to explain a bit more about hazards and toxicity. Chemicals that are found in the products such as formaldehyde are a known carcinogen and they're in the products. Now the extent of the hazard or toxicity depends on the exposure situation. Just because a chemical is in a product doesn't necessarily mean it poses a hazard or it will cause an adverse effect in a human. When we think about hazardous or potentially hazardous I just wanted to make sure to emphasise that everything depends on the exposure situation even though chemicals may have known toxicity or known to be carcinogens.

ANDI HORVATH:

If I compared outdoor air quality to indoor air quality which is worse?

ANNE STEINEMANN:

Well in most urban areas and industrialised countries the concentrations of hazardous air pollutants indoors are often several times if not several hundred times greater indoors than outdoors. If we look at it from a total exposure perspective, where are we exposed to our pollutants, more than 90 per cent of it occurs in indoor environments.

ANDI HORVATH:

I'm Andi Horvath and you're listening to Up Close. In this episode we're talking about indoor air quality and human health with Civil and Environmental Engineer Anne Steinemann. I want to move now to air quality and the related issues specifically in the home. In addition to some of the same issues we find in office buildings there are all those consumer products that are advertised to keep our environment and our bodies clean like air fresheners, deodorants, shampoos and the like. For most of us by the time we open our doors to head off to work we've already interacted with a dozen or so products. Anne, take us on a tour of consumer products. What's in them and how do they affect indoor air quality?

ANNE STEINEMANN:

Well I might preface this by saying I got interested in this topic because I had received emails from people around the world telling me they were becoming sick from common consumer products, products such as air fresheners, laundry supplies including detergents and fabric softeners and dryer sheets, personal care products, sunscreens, hand sanitisers, lotions and shampoos and a wide range of cleaning products. I'm trying to figure out what's in these products that are causing these effects because these are products that are supposed to be pleasing to people but people were reporting that they were becoming sick when exposed to them. So what I did is I analysed a wide range of consumer products to try to figure out what was in them. In my most recent study I analysed 37 of the best selling consumer products in the categories of air fresheners, laundry products, cleaning products and personal care products. About half of these had some claim of being green, organic, natural or non-toxic. What I found was surprising. These 37 products emitted collectively more than 550 different volatile organic compounds or VOCs. A VOC can be thought of as like a fume. Nearly one-fourth of these VOCs are classified as toxic or hazardous under US federal laws. However, these chemicals are not necessarily regulated in the products meaning they're either considered toxic or hazardous if

they're found in other environments or other media. For instance, if it's coming out of a smoke stack or a tailpipe it would be regulated. If it's coming out of an air freshener it was not regulated.

ANDI HORVATH:

Anne, how do we know that these VOCs become pollutants that become real neurotoxins and carcinogens that have an effect on the human body?

ANNE STEINEMANN:

Well this is a fascinating question because toxicity is very complicated as you might imagine. Chemicals can be toxic in and of themselves. They can also have additional or synergistic toxicity when combined with other chemicals and also the most common chemical I found in the fragrance products were terpenes, things such as limonene, alpha pinene, beta pinene. Now what's interesting is that terpenes themselves can have some inherent toxicity but when they get into the air they readily react with ozone to generate a range of secondary hazardous pollutants such as formaldehyde, acetaldehyde in ultra fine particles which are linked with lung and heart disease. This is very interesting because the chemicals individually can be toxic, together in mixtures they can have synergistic toxicity and then when they react in the air they can have a whole different range of secondary pollutants that they generate.

ANDI HORVATH:

Wow so it's not just the VOC in the air freshener, it's how it reacts to ozone in the air and creating a cocktail and a soup of VOCs that didn't exist before.

ANNE STEINEMANN:

Correct and we have very little information and knowledge about the toxicity of mixtures. Now when you asked your good question about how do we know VOCs are toxic well the question of what is toxic again is very complex because chemicals can have different effects on different people. The same chemical can cause someone to have a migraine headache or an asthma attack; there can be links with endocrine disruption, immune system dysfunction. Any chemical or mixture of chemicals can have a range of different effects in different people and then some individuals are more susceptible to chemical exposures as well. Another interesting point is the problem with low levels. People may think well these chemicals are at low levels and we shouldn't worry. Well not necessarily. Low levels can mean high risks for several reasons. One is we're not just exposed to one chemical at one low level at one time in our life. We're exposed to these chemicals in multiple environments, in multiple products and often times chronically and cumulatively throughout our lives. If we can think of cigarette smoking, people who smoke a couple of packs of cigarettes a day for their life it ends up in disease. So we have to think about the cumulative effects of chronic exposure to these chemicals. Another problem is that these chemicals are not in isolation. They're in mixture with other chemicals and we have very little information on how these mixtures of chemicals can ultimately harm human health.

There's another issue too and that's that some of these chemicals have non-monotonic dose-response relationships, which means lower levels can actually have

a more hazardous effect on human health. Things like endocrine disrupting chemicals can be hazardous at very low levels. There's a final point too; is that people have adverse reactions when exposed to small amounts of these products. So, instead of asking the question - well these chemicals are at low levels, people shouldn't be having effects, I look at it the other way, that we have significant and substantial scientific evidence that people have adverse health effects when exposed to these products and these mixtures of chemicals so what's in the products and what are the mixtures of chemicals and what are the exposure situations that are causing people to have these adverse health effects.

ANDI HORVATH:

Anne, tell me about products that are labelled non-toxic or organic and green. Are they any better?

ANNE STEINEMANN:

Well I'm glad you asked that question because that was the real focus of my study, this most recent one. I analysed 37 products. About half of them made some claim of being green, organic, all natural, non-toxic or with essential oils. Now what I found was that first of all, all products emitted potentially hazardous chemicals. There wasn't a single product that didn't. But another more striking point is there was not any significant difference in the potentially hazardous chemicals emitted from the fragrance products that were regular versus the fragrance products that claimed to be green, organic, natural or with essential oils. Basically if it had a fragrance in it it emitted potentially hazardous chemicals.

ANDI HORVATH:

What about aromatherapy products?

ANNE STEINEMANN:

There have been numerous studies that have analysed aromatherapy products and found that essential oils can emit potentially hazardous chemicals such as benzene and toluene, which are known carcinogens. Also from the epidemiologically studies that I've conducted, people do report adverse health effects when exposed to these products. Again I would caution people just because something says aromatherapy or essential oils it doesn't mean that it doesn't emit potentially hazardous chemicals.

ANDI HORVATH:

I'm Andi Horvath and our guest today is engineering Professor Anne Steinemann. We're talking about environmental pollutants in consumer products and the problem of indoor air quality right here on Up Close. Anne, is stricter regulation of indoor air quality the key?

ANNE STEINEMANN:

There is widespread recognition among government agencies that indoor air quality is a major problem. It's a major unaddressed health risk. In fact there have been studies indicating that indoor air quality is now the number one global environmental health risk. In Australia there's been a report citing that it leads to more than \$12 billion annually in lost worker health and productivity and the statistics are similar around the world. There is recognition that it's a problem, that it's an unaddressed

health risk but right now there are no major regulations addressing indoor air quality or even programs to monitor indoor air quality in Australia or in other major countries.

That's again the paradox. Even though there may be some laws to address worker health in certain occupational environments but in general our indoor environments are essentially unmonitored and unregulated yet it's a primary health risk. All that said there have been some voluntary movements to try and improve indoor air quality. An example of this are the fragrance-free policies which are sweeping the countries around the world, the recognition that reducing or avoiding exposure to fragrance can help those who are both sensitive to fragrance chemicals as well as help the general worker population.

ANDI HORVATH:

I imagine some individuals need to avoid the perfume department in department stores.

ANNE STEINEMANN:

Yes, fragrance is a term that really refers to a combination of several dozen to several hundred chemicals. Most of these chemicals are synthetic. Even fragrances called natural fragrances nonetheless have synthetic chemicals. So a fragrance is not just one chemical. It's a very complex mixture of chemicals and is often added to products, added to our consumer products, our shampoos, our soaps, our cleaning products or detergents.

ANDI HORVATH:

Anne, if we got the labelling right we could create new markets for better consumer products.

ANNE STEINEMANN:

This is what's so interesting. For foods all ingredients are required to be disclosed except for certain things such as flavours, which are very similar to fragrances. However, for general consumer products such as air fresheners, cleaning products, laundry products, those products do not need to disclose all ingredients and there is no law anywhere in the world that requires a disclosure of all ingredients in a chemical mixture called "fragrance". Now for the class of products like personal care products and cosmetics they do need to disclose their ingredients but they again can just say the term "fragrance" rather than disclosing the ingredients in the fragrance.

ANDI HORVATH:

I've noticed some building ratings around the country and this tends to refer to how green they are in terms of how energy efficient they are but they haven't addressed indoor air quality, have they?

ANNE STEINEMANN:

Well not necessarily. Some of these green building programs do have sections that provide credits for indoor air quality but they tend to be a very small part of the overall program. The focus on green buildings has traditionally been on energy

efficiency. Now what's interesting is that very energy efficient and tight buildings can concentrate the indoor air pollutants. There's been kind of this trade off between energy efficiency and indoor air quality. However, there's a trend now in green building to recognise the importance of health. Healthy buildings has now become like the new green buildings because companies and public agencies and the occupants of the buildings themselves are realising the benefits of having healthy indoor air quality because it leads to improved worker health and productivity, reduced healthcare costs.

ANDI HORVATH:

It makes economic sense.

ANNE STEINEMANN:

Absolutely.

ANDI HORVATH:

How can we spur greater public awareness of the issues?

ANNE STEINEMANN:

First of all by programs such as this where you could have researchers speaking about what they have found in their research because even though I consider it's an epidemic, there are buildings around the world that have indoor air quality problems, in fact it's hard to find a building that doesn't have some sort of indoor air quality problem but the public is now just gaining awareness of it. It's really three parts of this and one is the public, another is government agencies and another is industries and the manufacturers. With greater public awareness, when they become aware of the links between exposure to pollutants and health effects and also what they can do to improve their indoor air environments then I think that will bring around more attention by government agencies, more regulations and then the industry may start to reformulate products to make them acceptable to greater numbers of consumers.

ANDI HORVATH:

What can I do as an individual? For example, do indoor plants actually work?

ANNE STEINEMANN:

This is a great question because the good news is that there are things that we can do as individuals to improve our indoor air environment and there has been significant research done on plants and the ways that they can improve indoor air quality. Thinking about consumer products, people ask me well what should we use? Given that you've tested all these consumer products and they all emit potentially hazardous chemicals, what can we do? Well one recommendation is to go back to using what our grandparents used, very simple products to clean with such as vinegar and baking soda, what's called bicarbonate of soda because you can clean perfect well with combinations of these types of very simple products. You don't necessarily need combinations of chemical mixtures to clean well, also to think about dealing with the source of the pollutants rather than trying to mask them. For instance, instead of air fresheners which can emit a range of potentially hazardous chemicals and air fresheners are not designed to disinfect or clean the air. Instead of using chemical products to mask the problem, instead increase ventilation. Open

up a window.

ANDI HORVATH:

Anne, we all like to be fresh and clean but we may not want to use vinegar or bicarb so where do we go?

ANNE STEINEMANN:

A common question I get is given that I've tested all these consumer products and all the ones I tested emitted potentially hazardous chemicals, what options are there? Well what I recommend is that whenever possible choose fragrance-free versions of the products. Now the fragrance-free versions don't have the mixtures of fragrance chemicals that the studies have shown to be problematic for individuals. For instance, I conducted two national epidemiological studies in the United States and found that over 30 per cent of the population surveyed reported adverse health effects when exposed to fragrance products. These products are particularly a problem for people with asthma and other sensitive individuals. Even though a fragrance-free doesn't guarantee a non-toxic product because there can still be potentially toxic chemicals in the main product base, nonetheless it reduces the hazards associated with the addition of the fragrance chemicals. That's my main recommendation is to choose fragrance-free versions whenever possible and also in cases to avoid using things such as air fresheners which aren't designed necessarily to clean the air but instead add a range of chemicals to an existing air quality problem.

ANDI HORVATH:

Anne, a lot of people wear fragrances but there are a lot of people who are very sensitive like asthmatics. Can you comment on that?

ANNE STEINEMANN:

That's one of the most comment things I hear from people around the world is that they have adverse health effects due to other people wearing fragrance, using fragranced products, cleaning with fragranced products, using air fresheners, even washing their clothes in scented laundry detergents and dryer sheets. It's a problem that I've called "second-hand scents" referring to the adverse health effects caused by one person's wearing a fragranced product on other people. Now I've done several epidemiological studies of the links between exposure to fragranced products in asthma. What I've found is that fragranced products are a primary trigger of asthma attacks. I've found that air fresheners triggered asthma attacks in 40 per cent of asthmatics and scented laundry products triggered attacks in 20 per cent of asthmatics.

ANDI HORVATH:

That's extraordinary.

ANNE STEINEMANN:

Yes, in fact it's a problem for people in the workplace who have asthma because they often have to go home, they can't go to work, they love their jobs but they can't be in the office because of the use of scented products. A typical scenario, in fact I'm dealing with a case right now, is that there are two asthmatic women in a

workplace here and they're unable to be in the office because of the use of scented products in the workplace. Now they love their jobs, they want to be there but every time they go into work they get sick. They told their supervisors about the problematic products such as air fresheners. The supervisors look at the labels of the air fresheners and it says things such as organic perfume and essential oils. Then the supervisors say well look at these air fresheners, they're perfectly safe. They just have these very simple sounding ingredients but what people don't realise and this is what my studies revealed, is that these products don't disclose their ingredients. In my studies fewer than three per cent of any ingredients were disclosed and also claims such as green, organic, all natural, essential oils are very misleading and essentially meaningless because there are no regulations of these terms on consumer products. I should say that when it concerns foods ?certified organic? means something when it concerns food. There are very strict regulations for ?certified organic? but oftentimes consumer products and even some food products may toss around the term organic, green, natural, non-toxic in hopes perhaps to increase sales but what my studies have found is that chemically there's no real significant difference between these products and the other ones and that all the products emitted potentially hazardous chemicals.

ANDI HORVATH:

Anne, thanks for being our guest here on Up Close.

ANNE STEINEMANN:

Thank you so much, Andi.

ANDI HORVATH:

We've been speaking about indoor air quality and consumer product emissions with environmental pollutants expert, Anne Steinemann. She's Professor of Civil Engineering and the Chair of Sustainable Cities in the Department of Infrastructure and Engineering at the University of Melbourne. You'll find a full transcript and more info on this and all of our episodes on the Up Close website. Up Close is a production of the University of Melbourne, Australia. This episode was recorded on 23 April 2015. Producer was Eric van Bommel, audio engineering by Gavin Nebauer. Up Close was created by Eric van Bommel and Kelvin Param. I'm Dr Andi. Cheers.

VOICEOVER

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